Sight and Visibility

Understanding Sight

The world is largely known through the senses. The sense of sight is one of the most important senses. Through it we see mountains, rivers, trees, plants, chairs, people and so many other things around us. We also see clouds, rainbows and birds flying in the sky. At night we see the moon and the stars. You are able to see the words and sentences printed on this page. How is seeing made possible?

What Makes Things Visible

Have you ever thought how we see various objects? You may say that eyes see the objects. But, can you see an object in the dark? It means that eyes alone cannot see any object. It is only when light from an object enters our eyes that we see the object. The light may have been emitted by the object, or may have been reflected by it. You learnt in Class VII that a polished or a shiny surface can act as a mirror. A mirror changes the

direction of light that falls on it. Can you tell in which direction the light falling on a surface will be reflected? Let us find out.

Laws of Reflection

Reflection of Light

When a ray of light strikes a surface, it bounces back. The ray of light which strikes any surface is called the incident ray. The ray that comes back from the surface after reflection is known as the reflected ray. A ray of light is an idealisation. In reality, we have a narrow beam of light which is made up of several rays. For simplicity, we use the term ray for a narrow beam of light.

Law of Reflection

The angle between the normal and incident ray is called the angle of incidence ($\angle i$). The angle between the normal and the reflected ray is known as the angle of reflection ($\angle r$). If the experiment is carried out carefully, it is seen that the angle of incidence is always equal to the angle of reflection. This is one of the laws of reflection.

Plane of Reflection

The incident ray, the normal at the point of incidence and the reflected ray all lie in the same plane. This is another law of reflection.

Solved Examples

Practice Set

- **Level 1 – Easy:** Define the terms incident ray and reflected ray.

- **Level 2 – Moderate:** Explain why the angle of incidence is equal to the angle of reflection.
- **Level 3 – Challenging:** In an experiment, the angle of incidence is 30°. Calculate the angle of reflection and describe the path of the reflected ray.

Answer Key

- **Level 1:** Incident ray is the ray of light that strikes a surface. Reflected ray is the ray that bounces back from the surface after reflection.
- **Level 2:** According to the law of reflection, the angle of incidence is equal to the angle of reflection because the light ray bounces off the surface symmetrically with respect to the normal.
- **Level 3:** Angle of reflection = 30°. The reflected ray makes an angle of 30° with the normal and lies in the same plane as the incident ray and the normal.

Image Formation

Image by Plane Mirror

A plane mirror forms a virtual image of an object. The image appears to be behind the mirror at the same distance as the object is in front of it. The image is laterally inverted, meaning left and right are reversed. The image cannot be obtained on a screen because the reflected rays do not actually meet behind the mirror; they only appear to do so.

Multiple Images by Two Mirrors

When two plane mirrors are placed at an angle, multiple images of an object are formed. The number of images depends on the angle between the mirrors. For example, two mirrors at right angles (90°) produce three images. When placed parallel, infinite images are formed due to multiple reflections.

Solved Examples

Practice Set

- **Level 1 – Easy:** What is a virtual image? How is it different from a real image?
- **Level 2 – Moderate:** Two plane mirrors are placed at 60° to each other. How many images of an object placed between them will be formed?
- **Level 3 – Challenging:** Explain why infinite images are formed when two plane mirrors are placed parallel to each other.

Answer Key

- **Level 1:** A virtual image is an image formed by reflected rays that appear to come from behind the mirror. It cannot be obtained on a screen, unlike a real image where rays actually meet.
- **Level 2:** Number of images = (360°/angle) - 1 = (360°/60°) - 1 = 6 - 1 = 5 images.
- **Level 3:** When two mirrors are parallel, light reflects back and forth infinitely between them, creating an infinite number of images due to multiple reflections.

Regular and Diffused Reflection

Regular Reflection

When parallel rays of light fall on a smooth, polished surface, they are reflected in a single direction. The reflected rays remain parallel, producing a clear image. This is called regular reflection.

Diffused Reflection

When parallel rays fall on a rough or irregular surface, they are reflected in many different directions because the surface angles vary. This scattering of light is called diffused or irregular reflection. Diffused reflection does not produce a clear image.

Solved Examples

Practice Set

- **Level 1 – Easy:** Differentiate between regular and diffused reflection.
- **Level 2 – Moderate:** Why do we not see a clear image on a rough surface?
- **Level 3 – Challenging:** Explain how the law of reflection applies to diffused reflection.

Answer Key

- **Level 1:** Regular reflection occurs on smooth surfaces with parallel reflected rays; diffused reflection occurs on rough surfaces with scattered reflected rays.
- **Level 2:** Because the reflected rays scatter in different directions, no clear image is formed on a rough surface.
- **Level 3:** The law of reflection holds at each point on the rough surface, but since the surface orientation varies, reflected rays scatter.

Light and Colour

Sunlight and Dispersion

Sunlight is white light composed of seven colours. When white light passes through a prism, it splits into its constituent colours. This splitting of light into colours is called dispersion. Rainbows are a natural example of dispersion.

Solved Examples

Practice Set

- **Level 1 – Easy:** What is white light?
- **Level 2 – Moderate:** Explain dispersion of light with an example.
- **Level 3 – Challenging:** Why do different colours bend differently when passing through a prism?

Answer Key

- **Level 1:** White light is light that contains all seven colours combined.
- **Level 2:** Dispersion is the splitting of white light into its colours when it passes through a prism, as seen in a rainbow.
- **Level 3:** Different colours have different wavelengths and refractive indices, causing them to bend by different amounts in the prism.

Human Eye

Structure of the Eye

The eye is a spherical organ with several parts: the cornea (transparent front layer), iris (colored part controlling pupil size), pupil (opening controlling light entry), lens (focuses light), retina (light-sensitive layer), and optic nerve (transmits signals to the brain).

Working of the Eye

Light enters through the cornea and pupil, is focused by the lens onto the retina. The retina converts light into electrical signals sent to the brain via the optic nerve. The iris adjusts pupil size to control light intensity.

Blind Spot

The optic nerve connects to the retina at the blind spot, which has no sensory cells. Images falling on this spot are not seen, but the brain fills in the gap.

Care of the Eyes

Proper care includes regular checkups, using suitable spectacles, avoiding too little or too much light, not looking directly at the Sun, and maintaining a diet rich in vitamin A to prevent eye problems like night blindness.

Solved Examples

Practice Set

- **Level 1 – Easy:** Name the parts of the human eye involved in vision.
- **Level 2 – Moderate:** What is the function of the iris?
- **Level 3 – Challenging:** Explain the cause and effect of the blind spot in human vision.

Answer Key

- **Level 1:** Cornea, iris, pupil, lens, retina, optic nerve.
- **Level 2:** The iris controls the size of the pupil to regulate the amount of light entering the eye.
- **Level 3:** The blind spot is where the optic nerve connects to the retina and has no sensory cells, so images falling there are not detected, but the brain fills in the missing information.

Visual Impairment

Challenges and Adaptations

Some persons have limited or no vision due to birth, disease, or injury. They develop sharper other senses and use aids to read and write.

Non-optical and Optical Aids

Non-optical aids include magnifiers, Braille writer, tape recorders, and talking books. Optical aids include bifocal lenses, contact lenses, magnifiers, and telescopic aids.

Braille System

Developed by Louis Braille, it uses raised dots arranged in cells of two columns and three rows to represent letters and symbols. Visually impaired persons read by touching these dots.

Solved Examples

Practice Set

- **Level 1 – Easy:** Who invented the Braille system?
- **Level 2 – Moderate:** Describe the structure of a Braille cell.
- **Level 3 – Challenging:** How do visually impaired persons use optical aids?

Answer Key

- **Level 1:** Louis Braille invented the Braille system.
- **Level 2:** A Braille cell has six dots arranged in two vertical columns of three dots each.
- **Level 3:** Optical aids like magnifiers and telescopic lenses help visually impaired persons to see objects clearly or view distant objects.

Quick Reference Table

Common Mistakes and Misconceptions

Glossary